[ELEC 4010P] [Quantum Mechanics for Electronic Engineers] [Spring 2024] [Credits: 3]

Course Description

An introductory course on quantum mechanics for electronic engineers. This course will introduce the basic principles of quantum mechanics for electronic engineers with emphasis towards applications in semiconductor device physics and quantum information processing using electrons and photons. This course will provide the fundamental background in quantum mechanics for other senior electives in microelectronics and optoelectronics. Topics include mathematical preliminaries on probability, statistics, linear algebra; classical description of polarization, quantum states, operators, measurement, spin-1/2, angular momentum and rotation, time-evolution and the Schrödinger equation, position and momentum, wave mechanics, quantum confinement and tunneling, the harmonic oscillator, quantum information.

List of Topics

Lecture Outline

Week 1 Mathematical preliminaries
Week 2 Classical description of polarization
Week 3 Quantum states
Week 4 Operators
Week 5 Measurement
Week 6 Spin-1/2
Week 7 Angular momentum and rotation
Week 8 Time-evolution and the Schrödinger equation
Week 9 Position and momentum
Week 10 Wave mechanics
Week 11 Quantum confinement and tunneling
Week 12 The harmonic oscillator
Week 13 Quantum information

Laboratory Outline

Nil

Intended Learning Outcomes:

– An ability to apply fundamental knowledge of quantum mechanics to electronic engineering.
– An ability to communicate effectively using concepts in quantum mechanics.
– An ability to understand the technological impact of quantum mechanics.

Textbook(s):

Quantum mechanics: theory and experiment, Mark Beck, Oxford

Reference Books/Materials:

Quantum Mechanics for Scientists and Engineers, David A. B. Miller, Cambridge

Relationship of Course to Program Outcomes:

Please refer to the Report Section 4.3.2 (iii).

Grading Scheme:

Homework	40%
Laboratory	Nil
Course project (presentation/term paper)	10%/15%
Final Examination	35%